MATH 381
Introduction to Partial Differential Equations
Fall 2016

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Office hours are variable—make an appointment
Class meetings: MWF 1:00-1:50 in HB 227

The subject of partial differential equations is astonishingly broad[#], so in an introductory course hard choices have to be made concerning just what to include. I've decided we'll study 2nd order linear equations with real constant coefficients. And we'll actually restrict attention entirely to just three PDE's, all involving the wonderful Laplace operator. These are Laplace's equation, the heat equation, and the wave equation.

The major thrust of our course involves techniques for solving these equations in domains with a great deal of symmetry. One major technique is that of separation of variables. This technique then often leads to eigenvalue problems for second order ordinary differential equations subject to certain homogenous boundary conditions. These eigenvalue situations are often denoted as Sturm-Liouville systems. A prototype of this situation leads to a discussion of Fourier series, and this requires a fairly thorough basic discussion of such series.

When the resulting Sturm-Liouville system has variable coefficients (arising frequently from solving equations in a ball or a cylinder), then we are led to a study of various special functions such as Bessel functions and Legendre polynomials. We therefore spend some time discussing these important functions.

In infinite regions we are also led to a consideration of the Fourier transform instead of Fourier series.

The stress in this course is the above techniques, and not on proving theorems about solutions.

This course and MATH 423, PARTIAL DIFFERENTIAL EQUATIONS I, are essentially independent of one another.

Prerequisite: MATH 212
Recommended prerequisite: MATH 211

Text book: I am experimenting this year with writing notes for the class, and not using any text book at all. I'll probably hand out notes each day of class.

GRADING

Homework will be assigned regularly, You may certainly work together on these assignments.

There will probably be two midterm take-home exams.

There will be a final exam.

These are all extremely important, and I'll assign grades as follows:

HW 40%, Midterm exams 40%, Final exam 20%.

Footnote:[#] Here are examples of how broad the subject is:

1. MATH 382 is essentially the study of the solutions to the Cauchy-Riemann equation, a linear homogeneous PDE of order 1, with constant complex coefficients.
2. Hamilton's equations in Hamiltonian mechanics.
3. The Navier-Stokes equations are a system of nonlinear PDE's, which are the subject of one of the million dollar prizes from the Clay Mathematics Institute.